A Brief Tutorial on Dante Networking

PreSonus CONTRACTOR

Dante Networking

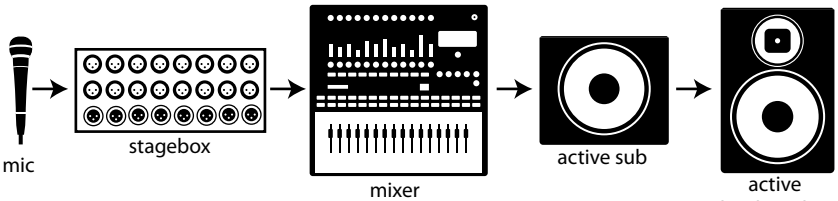
1. What is Dante?

Dante™ is an uncompressed, multi-channel digital media networking technology with near-zero latency and synchronization. Dante systems can easily scale from a simple network between a console and a computer to large, complex networks streaming thousands of audio channels. Because Dante uses logical routes instead of physical point-to-point connections, the network can be expanded and reconfigured at any time with just a few mouse clicks in Audinate's Dante Controller application.

2. Audio Networking Basics

Audio networks behave very much like an analog audio system in that audio networks consist of sources, destinations, and intermediate processing along the way.

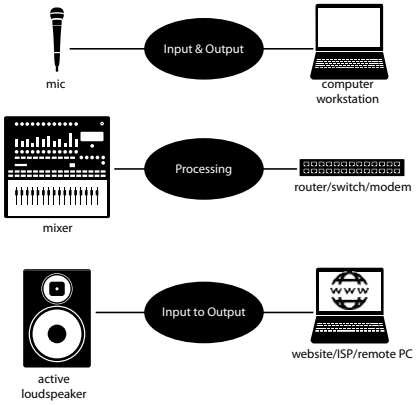
Let's look at a simple live-sound setup:



Basic analog flow

In the example above, an audio signal goes out of the microphone and into the stage box. It then goes to the mixer, where the microphone signal is amplified, routed to the appropriate output, and sent to an active subwoofer, where it is finally passed through to the full-range loudspeaker. All of this is readily apparent to any audio engineer just by looking at the diagram—a good thing because the skills needed to configure an analog system are nearly identical those needed by a network engineer.

Let's compare the audio system above with components in a network:



Analog to network diagram

Because experienced audio engineers understand signal flow and are accustomed to trouble shooting problems in an analog system at various points of weakness, configuring an audio network becomes that much easier.

2.1 Selecting the Right Network Switch

While Dante is compatible with standard network hardware, there are a few basic requirements to keep in mind when choosing your network switch. The following recommendations are based on the needs of a high-channel-count system (more than 32 channels).

- Non-blocking layer-2 gigabit switch with a packet-forwarding rate of 1.488 Mpps per port. For example, if you purchase an 8-port switch, the packet-forwarding rate would have to be 11.904 Mpps (1.488 Mpps x 8).
- Energy Efficient Ethernet (EEE), also known as Green Ethernet or IEEE 802.3az, reduces power consumption when there isn't much traffic on the network. Unfortunately, this can lead to audio interruptions and can degrade clocking. If your switch provides this feature, make sure that you can and do disable it.
- Managed switches are required if you plan to remote control a mixer or loudspeakers using UC Surface or SL Room Control via a wireless device, such as an iPad. Managed switches can also help you create a more stable Dante network if you have a complicated setup.
- Most managed switches support Quality of Service (QoS). This allows you to choose Dante clock synchronization as the highest priority and audio data as the next-highest priority. This is especially important if you are transferring large amounts of data over your Dante network or if you are transferring non-Dante data over the same network.
- If you are using multiple switches on your Dante network, we recommend using the same make and model to simplify setup and guarantee compatibility.

2.2 Adding a Wireless Router

Dante audio and routing cannot travel over a wireless network. You can still remote control devices that offer wireless remote control applications (like SL Room Control for StudioLive AI-series loudspeakers or UC Surface for StudioLive AI Mixers) over a Dante network, but you'll have to do a little more setup.

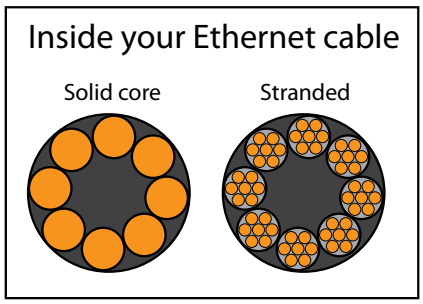
To connect a wireless router to your Dante network, you will need to have a managed switch and dive into its configuration settings. Select the port to which you've connected your wireless router and set Multicast Filtering to "On." This will stop the flow of Dante traffic to that port and allow it to be used for wireless remote control of your devices. Do not connect Dante devices to the ports on a wireless router. Please consult the documentation that came with your managed switch for instruction on enabling Multicast Filtering on a specific port.

2.3 Choosing the Right Cables

Be sure to use CAT5e or higher (CAT6 or CAT7) network cable. The CATE5e specification supports transmitting data up to 100 meters but cable and termination quality, as well as the environment in which the cable is used, can shorten this potential transmission distance. If you are making the connections yourself, it is important to note that if the cable is not properly terminated, it will not be capable of the maximum transmission distance.

Power User Tip: CAT5e cable checkers can verify long-distance transmission performance. These tools are readily available through many electronics and online retailers.

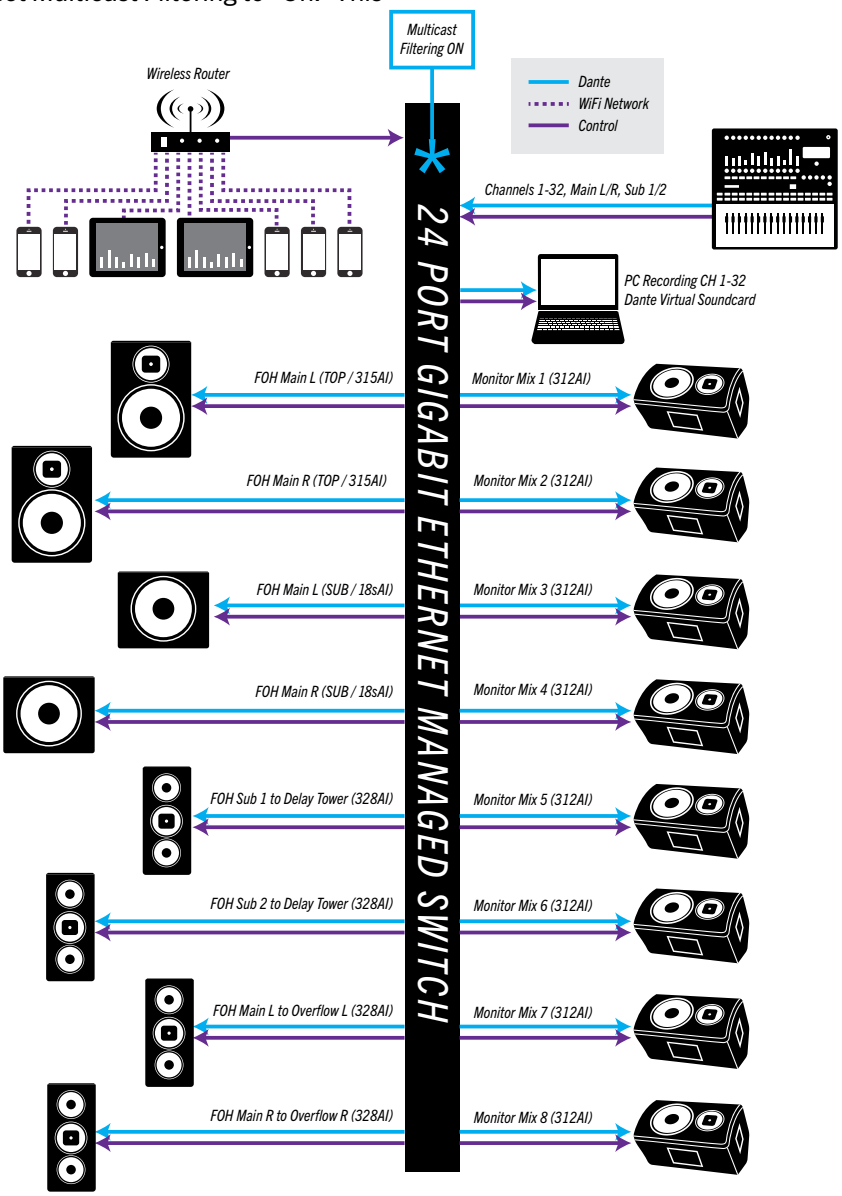
Another thing to keep in mind when selecting Ethernet cable is whether it is solid- or stranded-core. In a solid-core cable, each of the conductors is a single copper wire, which is a better fit for installations and long cable runs (more than 70m). Stranded-core cables use multiple, thinner copper wires for each conductor, making them more flexible and easier to handle. This makes stranded-core cable a better fit for touring and shorter cable runs.



To prevent electromagnetic interference, shielded twisted-pair (STP) cables are recommended. Unlike their unshielded cousins, STP cables have shielding that reduces noise. Like a balanced analog cable, STP cables have to be grounded, so you'll need to use STP-compatible RJ45 or EtherCon connectors.

2.4 Basic Dante Terms

Like all technologies, Dante uses special terminology to describe its core functions. Anyone using a Dante network should become familiar with them before creating a network.



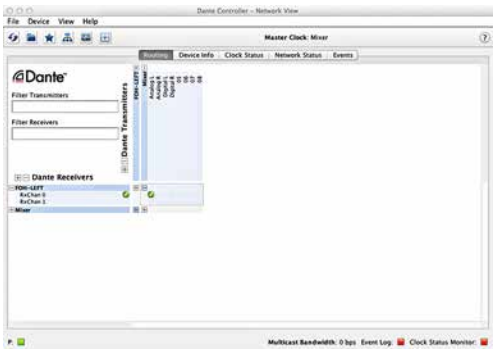
Managed Switch Network

- **Device:** A device means a Dante-enabled device (e.g., a StudioLive AI-series loudspeaker with the SL-Dante-SPK option installed).
- **Transmit (Tx) channel:** As its name suggests, a Transmit channel transmits audio from the audio hardware to the network.
- **Receive (Rx) channel:** A Receive channel receives audio from the network and sends it to the audio hardware.
- **Flow:** Dante audio routing creates flows. Each flow carries several channels of audio from a transmitter to one or more receivers. Unicast routing creates flows to single receivers. Multicast routing creates flows that can be received by multiple receivers. Multicast flows are assigned IDs, enabling them to be identified in Dante Controller.
- **Unicast routing:** Unicast flows are point-to-point from a single transmitter to a single receiver. Unicast flows typically have room for four channels of audio.
- **Multicast routing:** Multicast flows are one-to-many from a single transmitter to any number of receivers. Use Dante Controller to choose which channels are to be multicast. Unlike unicast routing, multicast flows consume network bandwidth even if there are no receivers but do not require additional bandwidth to add more receivers.
- **Subscription:** A subscription configures a Receive channel to receive audio from a transmit channel on another Dante device.
- **Subscription status:** For a Receive channel, subscription status indicates whether it is subscribed, whether it is receiving unicast or multicast audio, whether the subscription is okay, or whether an error has occurred.

2.5 Routing Audio on a Dante Network

For the most part, audio routing in Dante is done using the Dante Controller application. Dante Controller is a free software application that allows you to route audio and configure devices on a Dante network. With automatic device discovery, one-click signal routing, and user-editable device and channel labels, setting up a Dante network is relatively simple.

Dante Controller also provides essential device status information and powerful real-time network monitoring, including device-level latency and clock stability stats, multicast bandwidth usage, and customized event logging, enabling you to identify and resolve potential network issues. You can also back up, restore, move, and reuse Dante network configurations using presets and can edit Dante routing configurations offline.



Dante controller

To route audio on your Dante network, you will need a Mac or Windows computer with an Ethernet port and Audinate's Dante Controller application.

The Dante Controller application and associated documentation are available at www.audinate.com/products/software/dante-controller.

2.6 Dante Clocking

Dante uses distributed clocking but instead of sending a pulse every time a word starts, Dante uses IEEE 1588 (PTP) to synchronize the clock slaves to the master. Precision Time Protocol (PTP) achieves clock accuracy in sub-microseconds. Each device on the network has its own clock that runs the local digital audio. The local slave clock adjusts to stay in sync with the master clock by listening to messages sent periodically from the master to the rest of the network.

The advantage of using PTP is that if the master clock is suddenly unavailable, the local clocks continue to stay in sync while a new master is elected. Since the new master is already in sync with the old one, and all slaves only have a short window without a master, the master-clock role can be passed from device to device very quickly.

Dante Controller provides options to select a "Preferred Master," which has benefits, especially in fixed installations. However, if no preference is specified, Dante will use its own criteria to select the best master clock.

3. Frequently Asked Questions

Can I connect a Dante device directly to my computer?
Yes. Simply connect your Dante-enabled devices to an Ethernet switch, using CAT5e or CAT6 Ethernet cable, then connect your computer to the same switch.

If you have only one Dante-enabled device to connect to your computer, you can eliminate the switch and simply connect the two with a CAT5e or CAT6 Ethernet cable.

What type of Ethernet cable is recommended for Dante?
As most Dante devices support gigabit Ethernet, CAT5e or CAT6 cable is recommended. For purely 100 Mbps networks, CAT5 may be used.

Does Dante work with fiber optic network cable?
Yes. Because Dante works with standards-based networking technology, using fiber is simple. Use a switch that supports fiber connections to send Dante data over a fiber optic cable.

Ethernet is not copper- or fiber-based; it is independent of the cabling medium. Many organizations will have fiber already in place from other projects, and this can simply be reused on a Dante network.

Is it possible to make direct connections between Dante-enabled equipment?

Yes. Once routes are established with Dante Controller, a simple network of two Dante devices will work in a stand-alone fashion.

Can Dante devices be daisy-chained?

In most cases the answer is "no." Dante devices are connected via a network switch, which most often means a "star" topology: all devices are connected to a single central point, which minimizes the number of "hops" through which data must pass. This also avoids the scenario in which the failure of one device causes the entire chain to break.

Note: The secondary port found on some Dante devices is not to be used for daisy chaining; this is for Dante redundancy only. Please check your device's documentation.

Can Dante operate over a Wi-Fi network?

No. While possible in principle, the practical limitations of current wireless technology (802.11a/b/g/n) render reliable performance unachievable. For this reason Dante software such as Virtual Soundcard will not recognize wireless connections for audio data. Wireless access points for non-Dante traffic (device control, etc.) can be configured using managed switches.

Does Dante require any special network infrastructure?

No, special network infrastructure is not required. Since Dante is based upon universally accepted networking standards, Dante-enabled devices can be connected using inexpensive off-the-shelf Ethernet switches and cabling.

Does Dante require a dedicated network infrastructure?

No, a dedicated network infrastructure is not required. Dante-enabled devices can happily coexist with other equipment making use of the network, such as general-purpose computers sending and receiving email and other data.

Can you mix control data and audio on the same network?

Yes, audio can be sent over the same network as control information and even unrelated data traffic.

Does Dante require special switches?

No. However, we strongly recommend that gigabit switches be used due to the clear advantages in performance and scalability.

What is the minimum requirement for switches in a Dante network?

All Ethernet switches are capable of working with Dante. However, please be aware that there are some features on some kinds of switches that will allow you to build larger and more reliable Dante networks.

While gigabit switches are recommended, 100 Mbps switches may be used in limited scenarios.

- For channel counts of 32 or more, gigabit switches are essential. QoS is required when using Dante in networks that have 100 Mbps devices. QoS is also recommended for gigabit switches on networks that share data with services other than Dante.
- For lower channel counts (<32), a 100 Mbps switch may be used as long as it supports proper QoS, and QoS is active. The use of 100 Mbps switches without QoS is not recommended or supported.

What features are important when purchasing a switch?

Dante makes use of standard Voice over IP (VoIP) Quality of Service (QoS) switch features, to prioritize clock sync and audio

traffic over other network traffic. VoIP QoS features are available in a variety of inexpensive and enterprise Ethernet switches. Any switches with the following features should be appropriate for use with Dante:

- Gigabit ports for inter-switch connections
- Quality of Service (QoS) with four queues
- Diffserv (DSCP) QoS, with strict priority
- A managed switch is also recommended to provide detailed information about the operation of each network link: port speed, error counters, bandwidth used, etc.

Can I use switches with EEE (Energy Efficien Ethernet or Green Ethernet) in my Dante network?

Short answer: No.

Long answer: EEE (Energy Efficient Ethernet) is a technology that reduces switch power consumption during periods of low network traffic. It is also sometimes known as Green Ethernet and IEEE802.3az. Although power management should be negotiated automatically in switches that support EEE, it is a relatively new technology, and some switches do not perform the negotiation properly. This may cause EEE to be enabled in Dante networks when it is not appropriate, resulting in poor synchronization performance and occasional dropouts.

Therefore we strongly recommend that:

1. If you use managed switches, ensure that they allow EEE to be disabled. Make sure that EEE is disabled on all ports used for real-time Dante traffic.

2. If you use unmanaged switches, do not use Ethernet switches that support the EEE function because you cannot disable EEE operation in these switches.

What is Quality of Service (QoS)?

Quality of Service (QoS) is a feature of managed switches, which ensures that certain types of network packets (e.g. clock sync and audio packets) get preferential treatment and are "moved to the front of the line" ahead of other traffic. This is achieved by attaching a priority number to each packet, which is then used by the switches to ensure that high priority packets get processed before lower priority packets.

When do I need to use QoS in a Dante network?

QoS is required when using Dante in networks that have 100 Mbps devices and is optional in networks with gigabit devices. We recommend that QoS be enabled in all Dante networks in order to ensure proper operation under all possible conditions.

How does Dante manage QoS?

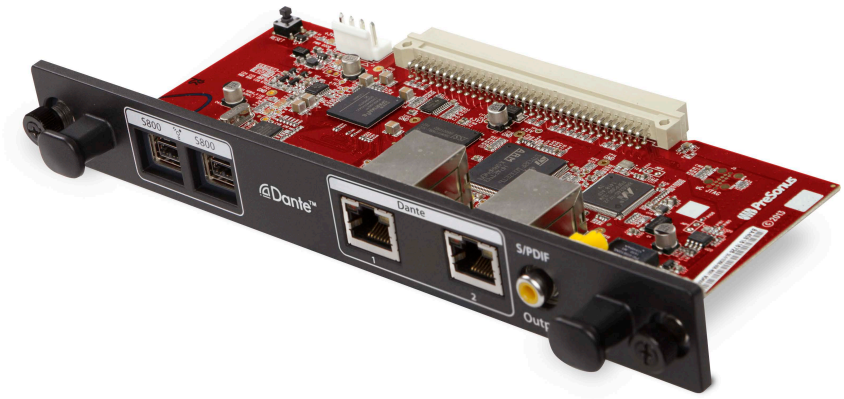
Dante uses standard Voice over IP (VoIP) Quality of Service (QoS) switch features to prioritize clock sync and audio traffic over other network traffic. QoS is available in many inexpensive and enterprise Ethernet switches. Any switch that supports Diffserv (DSCP) QoS with strict priority and four queues and has gigabit ports for inter-switch connections should be appropriate for use with Dante.

How does Dante use DSCP / Diffse v priority values when configuring QoS?

Switches prioritize packets using what are called DSCP/Diffserv values. Although Dante packet priority values have been chosen to make it simple to configure QoS with many switches, some switches require special configuration to recognize and prioritize specific DSCP values.

The table below shows how Dante uses various Diffserv Code Points (DSCP) packet priority values:

Priority	Usage	DSCP Label	Hex	Decimal	Binary
High	Time critical PTP events	CS7	0x38	56	111000
Medium	Audio, PTP	EF	0x2E	46	101110
Low	(reserved)	CS1	0x08	8	001000
None	Other traffic	BestEffort	0x00	0	000000



SL-DANTE-MIX Option Card for StudioLive AI Mixers

SL-DANTE-SPK Option Card for StudioLive AI Loudspeakers

Products With Dante Support:

StudioLive RM16AI Rack Mixer with UC Surface Control Software

PreSonus Digital Mixers

- StudioLive 16.4.2AI Console
- StudioLive 24.4.2AI Console
- StudioLive 32.4.2AI Console
- StudioLive RM16AI Rack Mixer
- StudioLive RM32AI Rack Mixer

PreSonus and WorxAudio Loudspeakers

- StudioLive 18SAI
- StudioLive 312AI
- StudioLive 315AI
- StudioLive 328AI
- StudioLive 328-iW
- StudioLive 328-iB
- WorxAudio TrueLine V5
- WorxAudio TrueLine V5M
- WorxAudio TrueLine X1
- WorxAudio TrueLine X115
- WorxAudio TrueLine X115i-P/D
- WorxAudio TrueLine X118i-P/D
- WorxAudio TrueLine X1M
- WorxAudio TrueLine X2i-P/D
- WorxAudio TrueLine X3
- WorxAudio TrueLine X3i-P/D
- WorxAudio TrueLine X5
- WorxAudio TrueLine X5i-P/D
- WorxAudio WaveSeries 12A
- WorxAudio WaveSeries 12M
- WorxAudio WaveSeries 15A
- WorxAudio WaveSeries 15S
- WorxAudio WaveSeries 18A
- WorxAudio WaveSeries 18S
- WorxAudio WaveSeries 218S
- WorxAudio WaveSeries 2AX
- WorxAudio WaveSeries 2MX
- WorxAudio WaveSeries 8A
- WorxAudio WaveSeries 8M

For more information on PreSonus support of the Dante protocol please visit:

www.presonus.com/dante

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